

A historical review of sustainable construction in Nigeria: a decade of development and progression

Review of
sustainable
construction in
Nigeria

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Abstract

Purpose – Research studies related to sustainability and green building have made monumental contributions to the concept of sustainable construction (SC) in Nigeria. This paper therefore aims to present a historical review of the development of SC in Nigeria over a 10 year period. The review also provides constructive perspective on the benefits of SC and the present state of enforcement of green building in Nigeria.

Design/methodology/approach – A historical review strategy was applied to the study. Using secondary data sources, 47 influential journals from emerald, scopus and science direct database focusing on “SC”, “sustainability” and “green building” in Nigeria between 2012 and 2022 were used for the analysis.

Findings – The analysis deduced that the development of SC in Nigeria have undergone a triple period of development: the inception period (2012–2016), the transition period (2016–2020) and the advancement period (2020–present). The review juxtaposes the three timeline to show rapid growth in the awareness of SC, but revealed moderate levels of implementation in some major cities in Nigeria. Therefore, the author finds and argues that the advancement of SC in Nigeria can be achieved through the synergy, commitment and active roles of researchers, academics, practitioners, policy makers and the government in enforcing existing green policies.

Originality/value – The study is the first academic paper to undertake a decade long historical review of SC in Nigeria. This review provides an up-to-date understanding of the developments, changing dynamics and future progressions in the field of SC in Nigeria.

Keywords Historical review, Sustainable construction, Green Building, Inception, Transition, Advancement, Progression, Implementation, Enforcement, Nigeria

Paper type Review paper

1. Introduction

The impact of human activities on the environment in the depletion of natural resources, air, water pollution, deforestation and global warming have increased the need to pay special attention toward implementation of sustainable development (SD) in the construction industry. Sustainable construction (SC), a subset of SD, is a vital agent in the preservation of world's resources and promoting the quality of life across the globe. A sustainable building aims to produce structures that enhances the quality of life and protects the environment efficiently and profitably, while a green building is a building which is energy efficient,

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resource efficient, and environmentally responsible. Sequel to the world commission on environment and development (WCED's) concerns about the need to protect the environment, [Ajao *et al.* \(2008\)](#) noted that the Federal Government of Nigeria (FGN) has emphasized that consistent effort is required by stakeholders for the adoption of SD in the country. These needs gave rise to sustainability becoming an increasingly important topic for construction research in Nigeria. In many ways, sustainability in Nigeria have reached an unprecedented peak. Unheard of decades ago, now over the past 10 years, many research have been conducted to create awareness and facilitate the implementation of SC in Nigeria.

With regards to the awareness and implementation of SC, to the best of the author's knowledge, the works of [Abolore \(2012\)](#), [Akadiri *et al.* \(2012\)](#) and [Dania *et al.* \(2013\)](#) were among the first series of academic literature to highlight the understanding and need for sustainability in Nigeria. Subsequent works by [Nduka and Sotunbo \(2014\)](#), [Isang \(2016\)](#), [Esezobor \(2016\)](#), and [Otali and Ujene \(2020\)](#) thereafter covered the same body of knowledge by expanding on the awareness and implementation of SC in Nigeria. For instance, [Abolore \(2012\)](#) and [Dania *et al.* \(2013\)](#) observed that the knowledge and understanding of SC is low, while [Isang \(2016\)](#) revealed that the awareness of sustainability practices is high and the practices are sub-consciously implemented in building projects. As time progressed, [Otali and Ujene \(2020\)](#) came up with the understanding that the level of adoption of sustainability practices among construction firms in Niger Delta region of Nigeria is moderate.

Thereafter, research gravitated from awareness and implementation to the drivers and barriers of SC. Among these were the works of [Daniel *et al.* \(2018\)](#), [Abisuga and Okuntade \(2020\)](#), [Udo and Udo \(2020\)](#), [Toriola-Coker *et al.* \(2021\)](#), [Omopariola *et al.* \(2022\)](#) and [Otali *et al.* \(2022\)](#). Inferences from these works show that education and training, government regulations and enforcement are among the driving factors of SC in Nigeria ([Abisuga and Okuntade, 2020](#); [Otali *et al.*, 2022](#)). On a different note, [Daniel *et al.* \(2018\)](#) and [Udo and Udo \(2020\)](#) identified inadequate knowledge and expertise, lack of strategy to promote SC and lack of demand as the greatest constraints faced in the bid to adopt SC. Similarly, [Toriola-Coker *et al.* \(2021\)](#) stated that poor sustainability education in academic institutions, ignorance of lifecycle cost benefits and resistance to cultural change in the industry are barriers to SC in Nigeria. There has also been a shift in focus toward the enforcement of green building (GB) in Nigeria. In this regard, [Oribuyaku \(2015\)](#) envisioned a new sustainable building code through a policy framework. [Abisugua and Okuntade \(2020\)](#), and [Babalola \(2020\)](#) developed a green policy framework for the implementation of SC practice that can be adapted in Nigeria. This indicates that, if a green building standard is enforceable, the built environment will be set up for a SC industry. However, the non-participation of the FGN, lack of enforcement of policies and strategy toward the concept of SC and GB tends to create a lacuna in the growth of the sector.

In proffering solutions to these gaps, several research studies have sought to improve the enforcement of SC and GB in Nigeria. Among such literature is the work of [Ifije and Aigbavboa \(2020\)](#) who revealed that, government should help with building policies to help push construction firms toward SC, and also awareness campaigns should be carried out so that clients would demand and be aware of the benefits of SC. On their part, [Omopariola *et al.* \(2022\)](#) highlighted cooperation, partnership and participation; protection of biodiversity and conservation of natural resources; and sustainability assessment system as the strategies for improvement. Overall, these studies have made significant contributions to the development of SC in Nigeria. Therefore, in light of this background, this paper aims to review the historical development of SC in Nigeria over a 10 year period, with the objectives of.

- (1) Tracing the evolution of SC in Nigeria from 2012 to 2022.
- (2) Mapping out possible future progression of SC in Nigeria.

- (3) Examining the present state of enforcement of GB in Nigeria.
- (4) Promoting the environmental and socio-economic benefits of SC in the Nigerian construction industry.

This study will update existing knowledge on the development of SC, the emerging trends in the field and will also discuss the practical benefits of SC and GB to promote its enforcement in Nigeria.

2. Methodology

2.1 Review strategy

This review is historical in nature. Historical review involves examining research throughout a period of time, often starting with the first time an issue, concept, theory, phenomena emerged in the literature, then tracing its evolution within the scholarship of a discipline. The purpose is to place research in a historical context to show familiarity with state-of-the-art developments and to identify the likely directions for future research ([University of Alabama Libraries, 2022](#)). This method was chosen to allow the author to gain a clear perspective on the past and present evolution of SC in Nigeria. The historical review was also applied to provide constructive updates on emerging trends and future progression in the field. The method was also used to enlighten the academic community on how the change in perspective on SC have developed over time. In the global context, SD has become a fundamental strategy to guide the world's social and economic transformation. This have propelled developed and developing countries such as the USA, China, England, India and Turkey. From the Nigerian perspective, this review should therefore generate international and national exposure on the environmental and socio-economic advancement of SC and GB for decades to come.

According to [Durai \(2021\)](#), reviewers use sources of information like raw materials and then fashion them into evidence to assemble a historical argument. In general, historical reviews are chronological in nature, but the reviewer can present it innovatively in thematic arrangement. In line with this understanding, the strategy for synthesizing the literature in this review is chronological. This is in tandem with the aim of the review, which is to provide a historical context for presenting the development of SC in Nigeria over a 10-year period. The review strategy groups historical developments by periods of time and documents how scholarly research and perspective have changed over time. Thus, this review covers the period of 2012–2022. This time period was selected based on the inception of SC in Nigeria to date. The review used secondary data sources from emerald publishing, scopus and sciencedirect. The selected database was chosen due to its vast, reliable and highly authoritative journals.

2.2 Search result

Data was gathered using search keywords such as “sustainable construction in Nigeria”, “sustainability in construction projects in Nigeria” and “green building in Nigeria”. Inclusion criteria included only peer reviewed journals and approved Masters or PhD thesis applicable to the Nigerian context. The search strategy was used to allow the author to identify influential scientific papers that made significant contribution to the field of SC in Nigeria. Given the thousands of articles published in the selected database, the search result was refined to 100. This were the articles accessible to the author. 50 were from emerald publishing, 30 from scopus and 20 journals from sciencedirect database. In the next step of the search strategy, duplicate papers and articles without full texts were sorted and discarded, leaving the author with 47 relevant data. The final analysis of the review consisted of 41 journals, 1 book chapter and 3 Dissertations in Nigeria. This were adjudged eligible and

were selected due its relevance to SC in Nigeria between 2012–2022. [Figure S1](#) presents a flowchart of the overall strategy applied in the historical review.

3. Literature review

Based on the method analysis, the author divides the development of SC in Nigeria into the inception period (2012–2016), the transition period (2016–2020) and the advancement period (2020–2022). [Figure S2](#) shows a chart-diagram illustrating the timeline of the periods of development of SC in Nigeria.

3.1 The inception period (2012–2016)

3.1.1 Evolution of sustainable construction in Nigeria. The construction industry plays an important role in national development by providing significant employment opportunities as well as the infrastructure and facilities required for other sectors of the economy to flourish ([Zuofa and Ochieng, 2016](#)). However, in meeting these roles, the industry employs vast pressure on global natural resources, thereby underscoring the relevance of the concept of SC. Sustainability in the construction industry in Nigeria grew in importance a decade ago, following increased awareness by the WCED about the need to minimize the negative impact of development activities on the environment and society. However, despite wide attention paid to SC by the global audience since 1987, the awareness and understanding of SC was lacking in Nigeria in the 20th century. Not until the works of [Abolore \(2012\)](#), [Dania et al. \(2013\)](#) reached the academic audience a decade ago. This studies made the most profound contribution to SC in Nigeria.

Since its inception, many research have explored vast aspects of SC in Nigeria, such as the environmental impact ([Abolore, 2012](#)), the theoretical construct ([Okoye and Okolie, 2013](#); [Amuda-Yusuf et al., 2020](#); [Oladokun et al., 2020](#)), while others have built on the principle ([Esezobor, 2016](#); [Isang, 2016](#)). Beginning in 2012, an emergent body of literature in Nigeria began to establish an understanding of the term “sustainable construction” and “sustainability in construction”. [Abolore \(2012\)](#) initiated the notion that the term SC and sustainability are often used interchangeably to describe the application of the principles of SD in the construction industry. The author also set the motion toward the awareness of SC by inciting civic consciousness among the people to build sustainably in the future. This was taken strongly and acted as a wake-up call for academics and researchers in the field of SC. By 2013, the work of [Dania et al. \(2013\)](#) observed that the concept of SC in Nigeria is relatively new among practitioners.

By 2014, [Abisuga and Oyekanmi \(2014\)](#) showed that the level of awareness is low in the Nigerian construction industry compared to more developed countries. [Dahiru et al. \(2014\)](#) agreed that lack of knowledge and awareness are the most prominent factors hindering construction of ‘green’ building and the adoption of sustainable practices in Nigeria. By 2015, calls were further made for a new sustainable code for built environment professionals and practice in Nigeria ([Oribuyaku, 2015](#)). This set the proposal for a vision policy framework. At the end of the inception period, sustainability in construction in Nigeria was established as the application of sustainability principles in the building practices. Its principle were adjudged to include: reduction resource consumption; reuse, recycle and renewable resources; protecting nature from all activities; minimizing or eliminating toxins; using full-cost accounting and creating environmental quality ([Isang, 2016](#)).

At the same time, the definition of SC was brought forward as the responsible supply, operation and maintenance of building that meets the needs of their owners and users over their lifespan with minimal unfavorable environmental impacts, while encouraging economic, social and cultural progress. In line with key aspects of this definition, many

scholars in Nigeria (Abolore, 2012; Babawale and Oyalowo, 2013; Dania *et al.*, 2013; Oribuyaku, 2015; Esezobor, 2016) agreed with the classification of SC as a multi-dimensional topic involving social, economic, and environmental aspects, often referred as the “three pillars of sustainability”. This theory remains a dominant force in Nigeria, as opposed to Hill and Bowen’s (1997) four attributes of sustainability; social, economic, biophysical and technical. Thus, at the inception period of the development of SC in Nigeria, environmental issues were recognized as a top priority. Eventually, socio-economic aspects were incorporated. Though varying definitions and interpretations of SC have been postulated, the principle and theory have remained constant. Research thereafter gravitated over the years from the inception period to the transition period.

3.2 The transition period (2016–2020)

3.2.1 Efforts of researchers and industry practitioners toward sustainable construction practice in Nigeria. The practice of SC is a global movement with countries developing plans, strategies, and policies to implement and utilize in their construction industries. This movement involves all stakeholders in the industry. However, considering the nature of human’s resistance to change, the paradigm shift from traditional method of construction to SC practice in Nigeria have not come without challenges. Recognizing this transition, in his work Esezobor (2016) stated that in view of the complexities of the Nigerian construction system, change toward sustainable practices will require education and training, information on dangers of non-sustainable practices and the benefits of sustainability in construction, coupled with effective implementation of regulations, leadership commitment and development of capacity to support SC. Building on this transition, in his multi-methodological study, Isang (2016) examined the level of awareness of sustainability practices in Akwa Ibom State, Nigeria, and found it to be high among building professionals. The author also revealed that sustainability practices are sub-consciously implemented on building projects. On this note, Onuoha *et al.* (2017) observed that inadequacies in the Nigerian young green building industry is a challenge to the formulation and implementation of policies and programs for sustainability in the construction industry in Nigeria. This observation shows that by 2017, there was a lack of adequate implementation, as there was no regulation in place to mandate the public and no active agency to enforce the practice. From that year on, effort was also made to improve the state of implementation of SC on building projects. The work of Oladokun *et al.* (2017) revealed that education and training programs for building professionals, competence and teamwork of professionals, and government regulations were the top three measures needed at the time.

As a result of this momentum, by 2018, Daniel *et al.* (2018) reasoned that sustainability module should be formally included in the built environment programs in higher education in Nigeria to deepen its knowledge among the construction professionals. Between the transition period, research also shifted its focus to what constitutes the drivers and barriers of SC. Tunji-Olayeni *et al.* (2018) identified five major drivers of SC to include clients’ demand, international pressure, corporate social responsibility, competitiveness and cost-effectiveness. By 2019, Akinshipe *et al.* (2019) indicated that inadequate knowledge and expertise, lack of strategy to promote SC and lack of demand were the greatest constraints faced in the bid to adopt SC in Nigeria.

Based on calls for training programs for building professionals, in the same year, the National Building and Road Research Institute (NBRRI) organized the first national workshop/training on sustainable building design and material specification. The workshop assessed the issues and challenges facing building sustainability in Nigeria and provided a panacea to mitigate the challenges. This was achieved through sharing of knowledge and

experience in the form of lectures, paper presentations, reports and discussions by relevant government and non-government organizations. By 2020, a research carried out by [Ifije and Aigbavboa \(2020\)](#) found that, building regulations and financial incentives were the main drivers of SC in Nigeria and lack of client demand and awareness and a general perception that adopting SC is expensive are the barriers. Following in the same line of thought, [Osuizugbo et al. \(2020\)](#) also revealed key barriers to SC in the Nigerian construction industry to include; poor government support for SC, lack of relevant laws and regulations to drive SC, lack of demand for SC from clients, low level of awareness of SC and fear of the cost of adopting SC. [Udo and Udo \(2020\)](#) found that inadequate knowledge and lack of expertise in SC practices are the greatest constraints faced in the bid to adopt SC. Around this time, [Amuda-Yusuf et al. \(2020\)](#) reiterated that stakeholders should direct efforts toward organizing seminars, conferences and workshops centered on SC through the various professional bodies at state and local government levels. When put together, this developments propelled SC practices in Nigeria from the transition period to the advancement period.

3.3 The advancement period (2020–2022)

3.3.1 Impact of academic literature in advancing sustainable construction in Nigeria. Among the literatures examined historically in terms of their contributions to advancing the adoption of SC in construction firms are ([Otali and Ujene, 2020](#)), on building projects ([Oladokun et al., 2020](#)), it's enforcement by the FGN ([Abisuga and Okuntade, 2020](#); [Babalola, 2020](#); [Tunji-Olayeni et al., 2020](#)) and improving strategies ([Omopariola et al., 2022](#)). During the advancement period, [Otali and Ujene \(2020\)](#) showed that the level of adoption of sustainability practices among construction firms in Niger Delta, Nigeria is moderate. [Oladokun et al. \(2020\)](#) reported that choosing the right construction method for resource conservation and consideration of the client's satisfaction are the major sustainability practices being implemented in building construction projects in Nigeria. This is the closest Nigeria gets in implementing SC on building projects, but not by way of enforcement by the FGN.

Also, by this period, some green building policy such as; the Green Building Council of Nigeria (GBCN), National Building Efficiency Code, Nigeria Building Code (NBC) and National Adaptation and Plan (NASPA) were established in Nigeria ([Abisuga and Okuntade, 2020](#)). [Tunji-Olayeni et al. \(2020\)](#) made four main recommendations with regards to the most appropriate policies for implementing SC Nigeria. These were: government regulations, provision of tax relief and subsidies and public awareness. The authors also indicated that existing green policy is not fully implemented due to the lack of government and leadership political will, policy compliance and enforcement, and lack of public awareness of green practice benefits. [Otali and Ujene \(2020\)](#) remarked that increasing top management support, human resource management, employee empowerment, training and educating employees on sustainability practices can improve the level of adoption of sustainability practices in Nigeria.

[Tunji-Olayeni et al. \(2020\)](#) identified common sustainable practices to include compliance with health and safety regulation, waste management, energy efficiency and material reuse. Additionally, around this time, [Babalola \(2020\)](#) observed that the knowledge and awareness of stakeholders (practitioners) is high. [Toriola-Coker et al. \(2021\)](#) interjected with the observation that poor sustainability education in academic institutions, lack of incentives for designers to facilitate sustainable design, ignorance of lifecycle cost benefits and resistance to cultural change in the industry are barriers to SC in Nigeria. By 2022, [Omopariola et al. \(2022\)](#) brought forward five unsustainable practices in Nigeria to include; negative externalities, excess energy, unsustainable technologies, non-management of health and safety of workers

and material waste. In their work, [Ekung et al. \(2022\)](#) noted that low knowledge of green building practices, non-familiarity with performance metrics, inadequate evidence and poor-risk perceptions distorts stakeholders' adoption to green building in Nigeria. In the same year, [Omopariola et al. \(2022\)](#) further revealed six new barriers of SC to include, absence of historical data and exemplary projects on which construction professionals can build and learn from; lack of professional to handle task; poverty and low urban investment; lack of urban and construction policy; lack of awareness; and lack of technical knowhow. For their part, [Otali et al. \(2022\)](#) identified availability of green materials, education and training, government regulations and enforcement as the emerging drivers of SC in the Niger-Delta region of Nigeria. All-together, these perceptions shows the changing nature of the knowledge, drivers, barriers and practices of SC in Nigeria over time. In view of this developments, the review further presents key progressions of SC in Nigeria.

3.3.2 Progression in the field of sustainable construction in Nigeria. As a result of undertaking the 10 years historical review of the development of SC in Nigeria, innovative trends have emerged. A number of studies ([Okoye and Okolie, 2013](#); [Babawale and Oyalowo, 2013](#); [Aghimiena et al., 2019](#); [Oke et al., 2021](#); [Adekunye and Oke, 2022](#); [Isang and Ebiloma, 2023](#)) have explored different aspects of sustainability in construction projects. [Abolore \(2012\)](#) and [Okoye and Okolie \(2013\)](#) applied environmental and social perspective to SC by showing that imbining environmental protection and safety culture through management commitment, safety training and education, and instituting regulatory framework promotes SC practice in Nigeria. Various inter-related studies have also applied significant aspects of sustainability to the Nigerian construction industry, with successful outcome.

For instance, [Babawale and Oyalowo \(2013\)](#) integrated sustainability into real estate valuation process. [Aghimiena et al. \(2019\)](#) applied data mining to SC in Nigeria, with inferences from their study demonstrating that the use of data mining within the Nigerian construction industry can assist in achieving sustainable project delivery during the transition period. In yet another area, [Oke et al. \(2021\)](#) explored cloud computing in SC in Nigeria, the study linked the benefits to successful construction project. The work of [Adekunye and Oke \(2022\)](#) also applied biomimicry principles to SC in Nigeria. More recently, during the corona-virus (COVID-19) pandemic, many research in Nigeria established that the construction workforce experienced project disruptions ([Ogunnusi et al., 2020](#)), adverse effects ([Yusuf et al., 2021](#)) and contractual disputes ([Salami et al., 2021](#)). In response, [Isang and Ebiloma \(2023\)](#) thematically showed that the holistic application of environmental, economic and social sustainability themes while incorporating managerial, contractual and governmental strategies can help in achieving sustainable project performance in the post-COVID era in Nigeria. Additional progression in the field shows a continuous need for the enforcement of SC and GB policy framework in the Nigerian construction industry.

3.3.3 The state of enforcement of sustainable construction or green building practice in Nigeria. The negative impact of construction activities on the economy and the environment have necessitate the need for a green policy in Nigeria. However, due to its over-reliance on the government for policy directions, not much has been done in Nigeria. [Mbamali and Okotie \(2012\)](#) argued that there are no such policies, regulations or professional councils or bodies to enhance knowledge in the SC domain and generally promote socio-economic and environmental sustainability. [Oribuyaku \(2015\)](#) called for a new sustainable code for built environment professionals and practice in Nigeria through a proposal for a vision policy framework. According to [Onuoha et al. \(2017\)](#) perceived inadequacies in the Nigerian young green building industry is a challenge to the formulation and implementation of policies and programs for sustainability in the construction industry in Nigeria. This shows a lack of adequate implementation as there were no regulations in place to mandate the public and no active agency to enforce SC practices.

However, [Abisuga and Okuntade \(2020\)](#) identified Green Building Council of Nigeria (GBCN), National Building Efficiency Code, Nigeria Building Code (NBC), and National Adaptation and Plan (NASPA) as the existing green building policies in Nigeria. [Babalola \(2020\)](#) developed a policy model for the implementation of SC practice in Nigeria. The study shows that this will require a total revisit and overhauling of existing planning and construction policies from the design, materials selection, construction to maintenance of construction facilities in the National Building Code in Nigeria. [Abisuga and Okuntade \(2020\)](#) also formulated a green policy framework that can be adapted in Nigeria. Analysis from their study shows that, for this policy framework to be effective, government at all levels (federal, state and local) through separate administrative organizations, policy advocacy groups, politicians, construction stakeholders and the citizenry should be involved in the formation, enforcement and utilization of the green building public policy in the Nigerian construction industry. To that end, there should be a sustainable environmental and socio-economic policy or legislation that will motivate construction clients to adopt it. However, by 2022, the GBCN successfully attained membership in the World Green Building Council (WGBC) ([GBCN, n.d.](#)). This represents a significant milestone in Nigeria's drive to achieve environmental and socio-economic benefits of GB and SC.

3.3.4 Environmental and socio-economic benefits of sustainable construction in Nigeria. Several research in Nigeria have touched on the benefits of SC and the value of its application ([Nduka and Sotunbo, 2014](#); [Isang, 2016](#); [Abisuga and Okuntade, 2020](#); [Alohan and Oyetunji, 2021](#); [Okoye et al., 2021](#)). The work of [Nduka and Sotunbo \(2014\)](#) revealed that pursuing active recycling, conserving natural resources, preventing global warming, decreasing environmental damage cost, improving productivity are the five major benefits of green building in Nigeria. [Isang \(2016\)](#) highlighted three environmental, social and economic benefits to be reaped by contractors, clients, occupants and construction workers from building more sustainably. This includes; Improved health, comfort, and productivity/performance; Lower construction and operating costs; Increased building value.

[Abisuga and Okuntade \(2020\)](#) indicated that proficient use of energy, water, and other valuable resources, securing the inhabitant health and ensuring efficiency, and productivity, reducing waste, contamination and natural debasement are the benefits of SC. In analyzing their study, the author finds that green building is less expensive (except in cases where retrofitting of existing buildings is carried out), it has less operating risk, low maintenance and replacement cost, and it brings consistent temperature and humidity, high indoor air quality, low environmental impact and efficient waste management. The work of [Alohan and Oyetunji \(2021\)](#) showed that enhancing occupants' comfort and health, improving internal air quality, productivity and the occupants' satisfaction, creating new opportunities for other industries to benefit, innovation in the construction industry, reduced aggregate future capital and maintenance costs, as well as creating and increasing job opportunities in the construction industry are the perceived benefits of green building in the Nigerian construction industry.

[Okoye et al. \(2021\)](#) found that increase profitable and competitive advantage, minimization of material waste, reduction of global warming, and climate change, reduction of operational and maintenance cost and improved indoor environmental quality are among the benefits of SC practice. Thus, the environmental and socio-economic benefits SC can be seen in the successful implementation of GB projects in Nigeria such as, Primetech's head office, Abacus One Estate in Abuja, the Nestoil Tower, the Heritage building, the Wing and Alliance building in Lagos. Therefore, in light of this, practitioners should engage in community or professional group and local partnership with non-professional stakeholders, so as to create an interface that promotes the benefits of sustainability in Nigeria. [Table S1](#) captures a cross-sectional representation of research that have made significant contributions to SC or GB in Nigeria.

4. Discussion of findings

As a result of the historical review, the author established that the development of SC have progressed through the inception period (2012–2016), the transition period (2016–2020) and the advancement period (2020–2022). Insights from the review reveals that the inception period of SC in the Nigeria construction industry brought about low understanding and implementation compared to more developed countries (Abolore, 2012; Dania *et al.*, 2013; Abisuga and Oyekanmi, 2014). This can be attributed to the concept still being at its infant state at that stage in Nigeria. However, with the progressions of time came high levels of awareness, while the implementation was adjudged to be carried out subconsciously on building projects (Isang, 2016).

Findings also show that during the transition period, more effort was now geared toward transitioning from traditional method of construction to SC in Nigeria. This shift in paradigm required education and training, information on dangers of non-sustainable practices and the benefits of sustainability in construction, coupled with effective implementation of regulations and leadership commitment (Esezobor, 2016). This implies that, more work is still needed in educating and training building professionals, and enforcing government regulations to drive the implementation of SC and GB in Nigeria. The review also registered major progression between 2016–2020 such as the application of data mining to SC in Nigeria (Aghimien *et al.*, 2019). This shows the benefits to be had in exploring innovative trends in the field in Nigeria.

During the advancement period, the built environment also recorded moderate levels of implementation of sustainability practices in Nigeria (Otal *et al.*, 2020). Nonetheless, the absence of historical data and exemplary projects on which construction professionals can build and learn from was observed to constitute a barrier to SC in Nigeria (Omopariola *et al.*, 2022). In contrast, this review finds and updates previous works that there have been successful GB projects implemented in Nigeria. Among this are Primetech's head office in the capital city of Abuja and the Nestoil Tower in Lagos constructed by Julius Berger Nigeria plc. Others include the Heritage building, the Wing and Alliance building in Lagos, and the Abacus One Estate in Abuja constructed by KARMOD innovative construction company.

5. Conclusions and recommendation

For over a decade, the concept of SC in Nigeria has evolved from initial obscurity to a thriving field. This paper therefore presented an up-to-date historical review of the development of SC within a 10 year period in Nigeria. Based on a synthesis of secondary data, the review concluded that SC in Nigeria have undergone different periods of development. The paper combined all aspects SC to develop three timelines: the inception period (2012–2016), the transition period (2016–2020), and the advancement period (2020—present). The review contributed to the body of knowledge by showing a rapid awareness of SC in Nigeria from 2016, despite moderate levels of implementation. In revealing GB successfully implemented in Nigeria, the paper recorded prominent projects to include, Primetech's head office and the Nestoil Tower in Abuja and Lagos respectively. The review further provides the update that, as of 2022, the GBCN attained membership in the WGBC, while SC was also applied to data mining, cloud computing, bionimicry, estate valuation and during the COVID-19 pandemic for successful project delivery. This significant achievements have helped in shaping SC to its present state in Nigeria.

The practical implication of this review for academics in higher institution of learning lies in understanding the developments of SC, this will assist them in increasing students' understanding and awareness in the university environs. Researchers in the field of sustainability will benefit from this paper by gathering new ideas on future progression in SC, this will give them a point of reference for their future studies. Practitioners in the Nigerian construction industry will find this review useful in expanding their knowledge on the environmental and socio-economic benefits of

implementing SC on their building projects. The Government will use this paper to make informed decisions that impacts the country's socio-economic society. Policy makers will gain knowledge on the present state of enforcement of SC in Nigeria.

The limitation of this paper lies in its inability to capture the inexhaustible amount of literature covering sustainability and GB in Nigeria, therefore the works used in this review may be limited. The paper recommends the full enforcement of existing green policies and sustainable building regulations in Nigeria, this will help in advancing the environmental and socio-economic benefits toward a "sustainable construction industry" in Nigeria. New directions for future studies arising from this work, can be expanded on the benefits of SC and its state of enforcement as of 2023.

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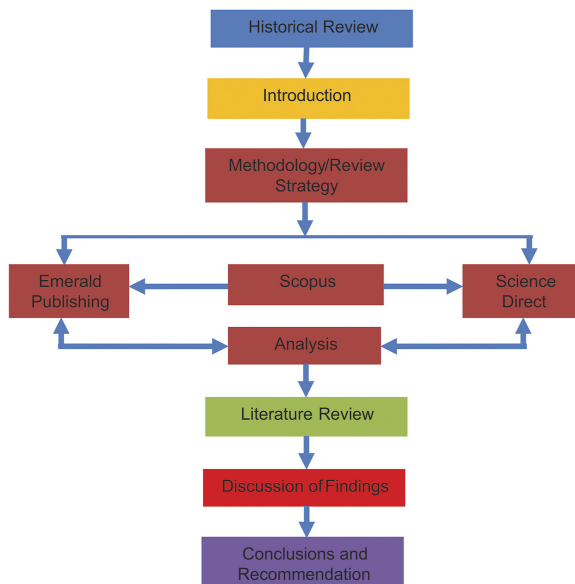
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Further reading

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Supplementary material



Sources(s): Figure by author

Figure S1.
Flowchart of the
overall strategy
applied in the historical
review

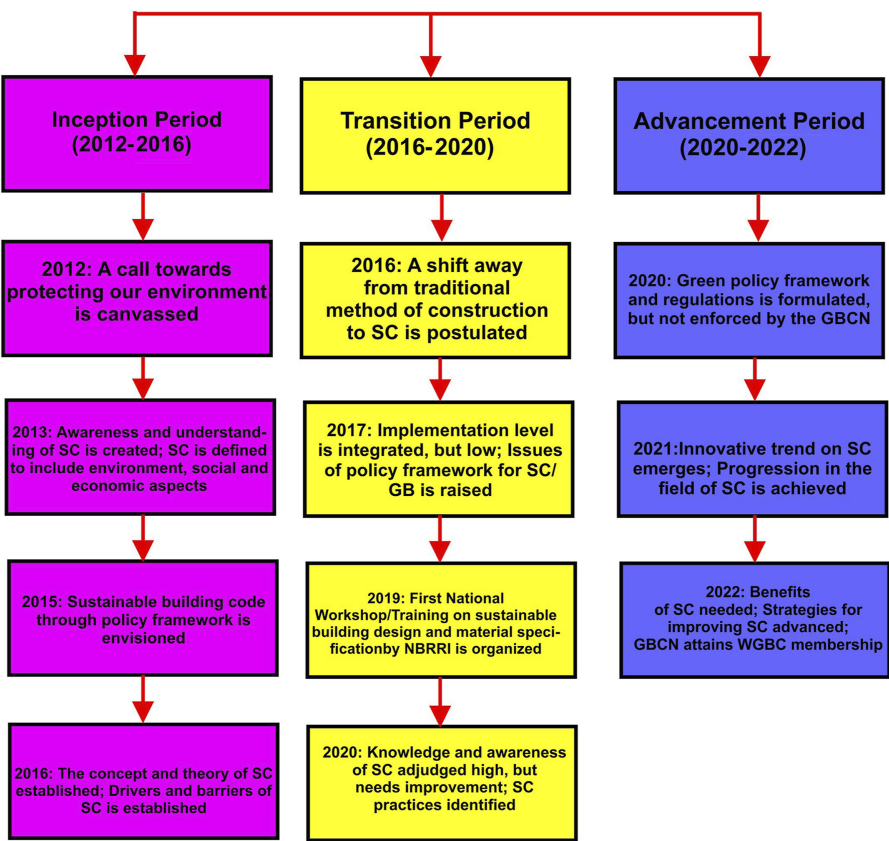


Figure S2.
Chart-diagram
illustrating the timeline
of the periods of
development of SC in
Nigeria

Source(s): Figure by author

Area of contribution	Researcher(s)	Year
Awareness, implementation of SC	Abolore, A.A	2012
Implementation of SC	Akadiri <i>et al.</i>	2012
Awareness of SC	Dania <i>et al.</i>	2013
Awareness, SC in estate valuation	Babawale and Oyalowo	2013
Benefits of SC	Nduka and Sotunbo	2014
Enforcement of SC	Oribuyaku, D	2015
Awareness, implementation, drivers, barriers	Isang, I.W	2016
Implementation of SC	Esezobor, E.L	2016
Awareness, integration of SC	Zuofa and Ochieng	2016
Enforcement of GB	Onuoha <i>et al.</i>	2017
Strategies for SC	Tunji-Olayeni <i>et al.</i>	2018
Data mining for SC	Aghimiena <i>et al.</i>	2019
Constraints of SC	Akinshipe <i>et al.</i>	2019
Enforcement of SC and GB	Babalola, A.A; Abisuga and Okuntade	2020
Implementation, awareness of SC practices	Oladokun <i>et al.</i>	2020
Adoption of SC	Otali and Ujene	2020
Barriers of SC	Osuizugbo <i>et al.</i>	2020
Cloud computing for SC	Oke <i>et al.</i>	2021
Benefits of SC	Okoye <i>et al.</i>	2021
Biomimicry principles for SC	Adekunye and Oke	2022
Benefits, adoption of GB	Ekung <i>et al.</i>	2022
Practices, barriers and strategies of SC	Omopariola <i>et al.</i>	2022
Note(s): SC (Sustainable Construction); GB (Green Building)		
Source(s): Table by author		

Table S1.
Cross-sectional
representation of
research that have
made significant
contributions to SC and
GB in Nigeria

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